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KEY TERMS Cataclysmic variable--Light measurement

ABSTRACT

In 1989, we used the Beijing Astronomical Observatory Xinglong observation station's 60/90/180 centimeter Schmitt telescope as well as Thomson red sensitive CCD to carry out luminosity observations on 14 PG candidate cataclysmic variables. The luminosity curve characteristics clearly show that PG0027 + 260, PG0818 + 513, and PG 1030 + 590 are cataclysmic eclipsing binaries. PG1341--079 is a possible cataclysmic eclipsing binary. PG1551 + 719 is an SU UMa type dwarf nova. Besides this, there are also light change curves associated with 6 celestial bodies which have flickering characteristics of cataclysmic variables. As a result, among PG samples, the success rate for cataclysmic variables is 79%. PG1030 + 590's orbital period is $3^{h}.279$. PG1717 + 413's flickering change range clearly varies within two months. There is no clear correlation between it and intrinsic brightness. The explanation is that the flickering range changes may possibly be localized effects associated with brightness bands.

1 INTRODUCTION

Palomar Green (PG) sky searches ($|b| \geq 30°$, mv $\leq$ $16^{m}5$) have found a total of 1878 individual UVX celestial bodies [1]. After going through slit optical spectrum observations, 22 cataclysmic variable (CV) candidates were selected [2]. If one wants to finally confirm their CV characteristics, there is a need for light change curve data. In March, 1989, we began--at the Beijing Astronomical Observatory Xinglong station--to make use of the 60/90/180 centimeter Schmitt telescope as well as Thomson thick red sensitive CCD to carry out differential CCD light measurements on 14 objects among them. This article gives observation results.

2 OBSERVATIONS

Table 1 is the detailed status of observations. The first column is the name of the celestial object using PG nomenclature. The second column is observation date and start and stop times all converted to GMT. The third column is the integration time associated with each observation point. The fourth column is the light filter used during observations. The final column is remarks. On the basis of light change curves, determinations are made of whether celestial objects are cataclysmic variables (CV), cataclysmic eclipsing binaries (CB), or SU UMa type dwarf novae. As far as methods used in observations are concerned, multiple target optical change curve software packages as well as data convergence calculations are in all cases the same as reference [3].

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Table 1 List of Objects Observed

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Object	Duration (UT)			Integration Time (s)	Filter	Note
	date		start—end h m h m			
PG0027 + 260	1989	11 30	11:00—18:00	100	R	CB
PG0244 + 104 (WX Ari)	1989	10 31	20:00—21:30	60	V	CV
PG0818 + 513	1989	3 27	12:30—20:00	60	N	CB
		4 2	11:30—19:00	60	N	
PG0834 + 488	1989	3 24	12:31—15:31			CV
PG0849 + 580	1989	3 28	12:49—16:14	100	N	CV
		3 14	11:52—13:45	30	N	
PG0917 + 342	1989	3 30	12:34—19:14	60	N	CV
PG0948 + 344	1989	4 1	12:02—15:18	30	N	CV? $0^m.1$ light flickering
PG1030 + 590 (DW UMa)	1989	3 14	14:40—17:28	300	V	CB
		3 20	14:45—20:56	150	H_α, R	
		3 21	13:11—19:18	150	R	
PG1341 − 079	1989	4 1	16:21—20:48	120	N	CV
		4 3	15:46—20:51	120	N	
PG1551 + 719 (SS UMi)	1989	3 13	16:49—21:36	300	V	CV, SU UMa
		9 6	13:15—16:50	150	V	
		9 10	18:07—20:37	60	V	
PG1711 + 336 (V795 Her)	1989	3 14	18:15—21:29	120	V	CV
		3 19	18:07—21:26	120	H_α	
PG1717 + 413	1989	4 8	18:22—20:55	15	N	CV
		4 9	16:29—20:55	15	N	
		6 26	15:37—18:48	15	N	
		6 27	13:15—14:07	10	N	
		6 27	16:06—19:37	10	N	
		7 28	13:07—14:30	10	N	
PG2240 + 193 (KQ Peg)	1989	7 27	16:03—20:05	30	N	CV?
PG2300 + 166	1989	7 26	17:51—19:28	5	N	CV?
		11 5	11:58—14:32	60	R	
		11 6	11:10—13:10	10	R	

3 RESULTS AND DISCUSSION

The main results associated with observations of 14 candidate PG cataclysmic variables are summarized as follows.

1. On the basis of light change curves we observed, among those for which it is possible to determine that they are cataclysmic eclipsing binaries (CB), and, in conjunction with that, solve for their orbital periods, there are PG0027 + 260[4], PG0818 + 513[5], and PG1030 + 590. The orbital periods of the first two celestial bodies have already been published. /227 With regard to PG1030 + 590, our total of five observations is extremely small. Using visual estimates of extremely small instants of time, precisions are 6 seconds. Because of this, orbital periods which were determined were $P = {}^{h}3.279 = {}^{d}0.13663 \pm 0.00007$. This conforms, within a range of error, with orbital periods $P = {}^{d}0.13660653 \pm {}^{d}0.00000005$[6] worked out using the observational materials of Shafter and others from 1983-1986. As far as further observations by Thorstensen and others of PG0027 + 260 are concerned--besides verifying the periods we determined--there were published optical spectrum and polarized results [7].

2. PG1551 + 719 was confirmed as being an SU UMa type dwarf nova. Three super outburst observations were made. In conjunction with this, the Superhump period was solved for as 101 minutes. From this, the orbital period was determined to be 98 minutes [8].

3. There is a possibility that PG1341-079 is also a cataclysmic eclipsing binary. However, its period has still not been determined.

4. Among celestial bodies whose natures as cataclysmic variables are determined from flickering phenomena associated with light change curves, there are PG 0834 + 488, PG0849 + 580, PG0917 + 342, PG1711 + 336, PG1717 + 413, and PG0244 + 104.

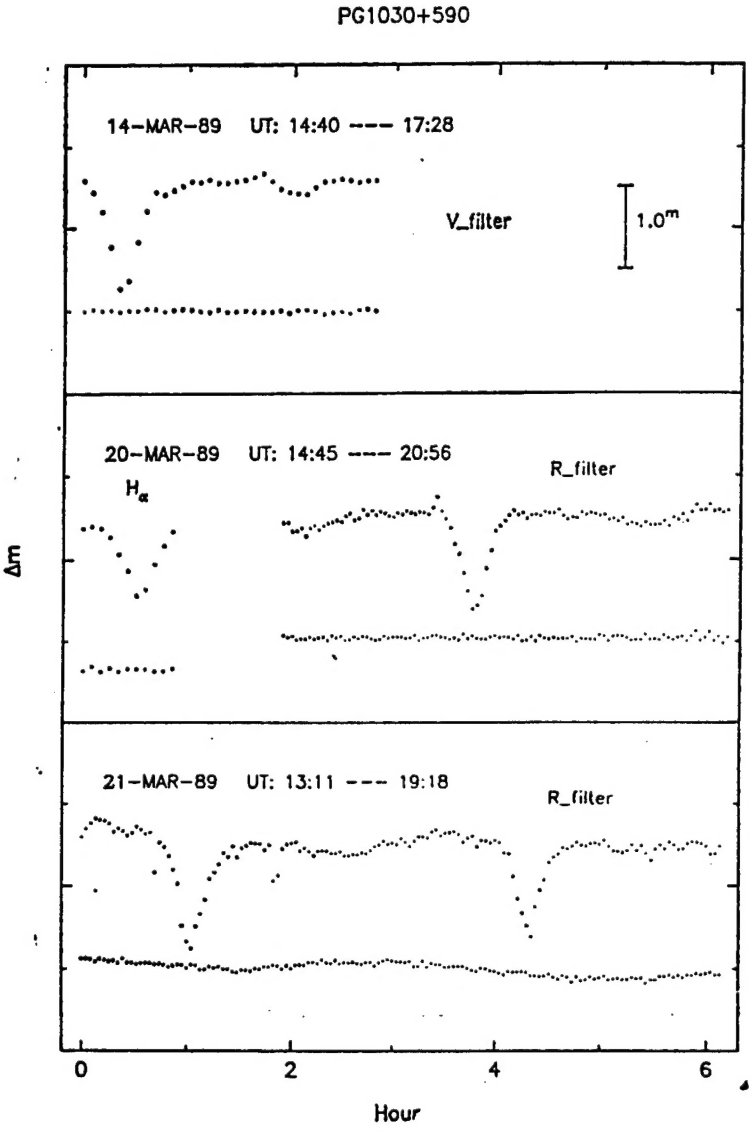

PG1030+590
14-MAR-89 UT: 14:40 --- 17:28
V_filter
1.0m
20-MAR-89 UT: 14:45 --- 20:56
Hα
R_filter
Δm
21-MAR-89 UT: 13:11 --- 19:18
R_filter
0
2
4
6
Hour

Fig.1

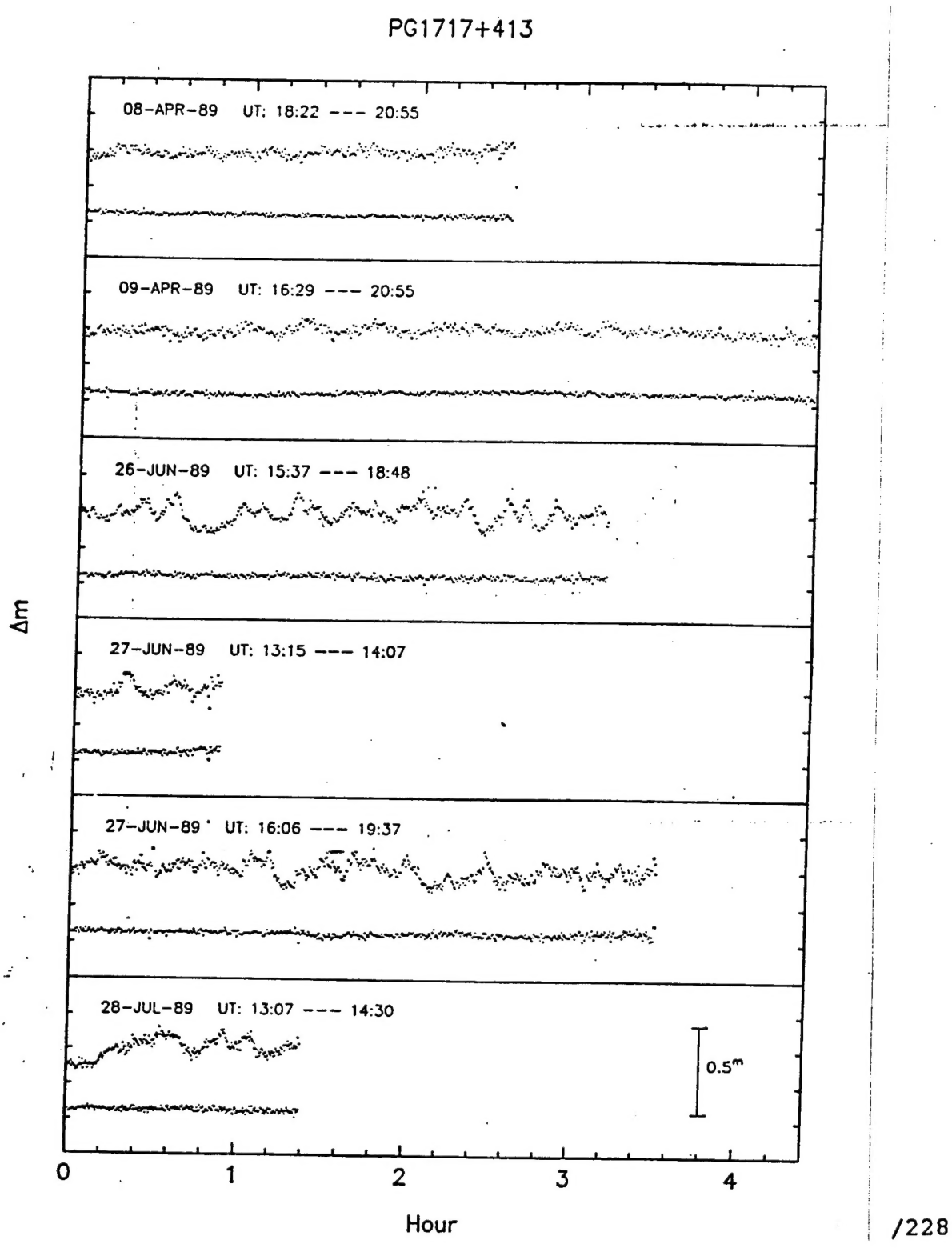
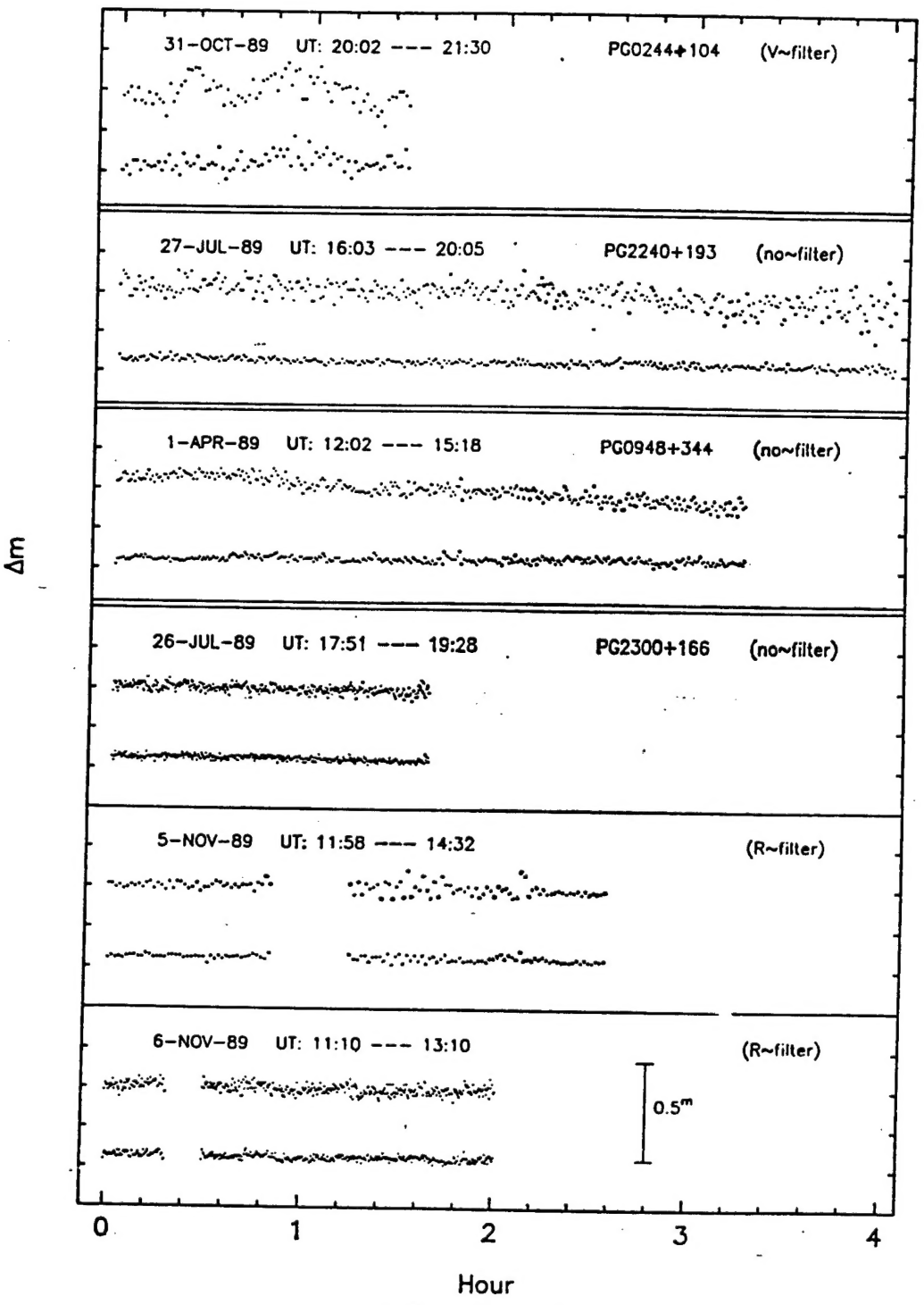
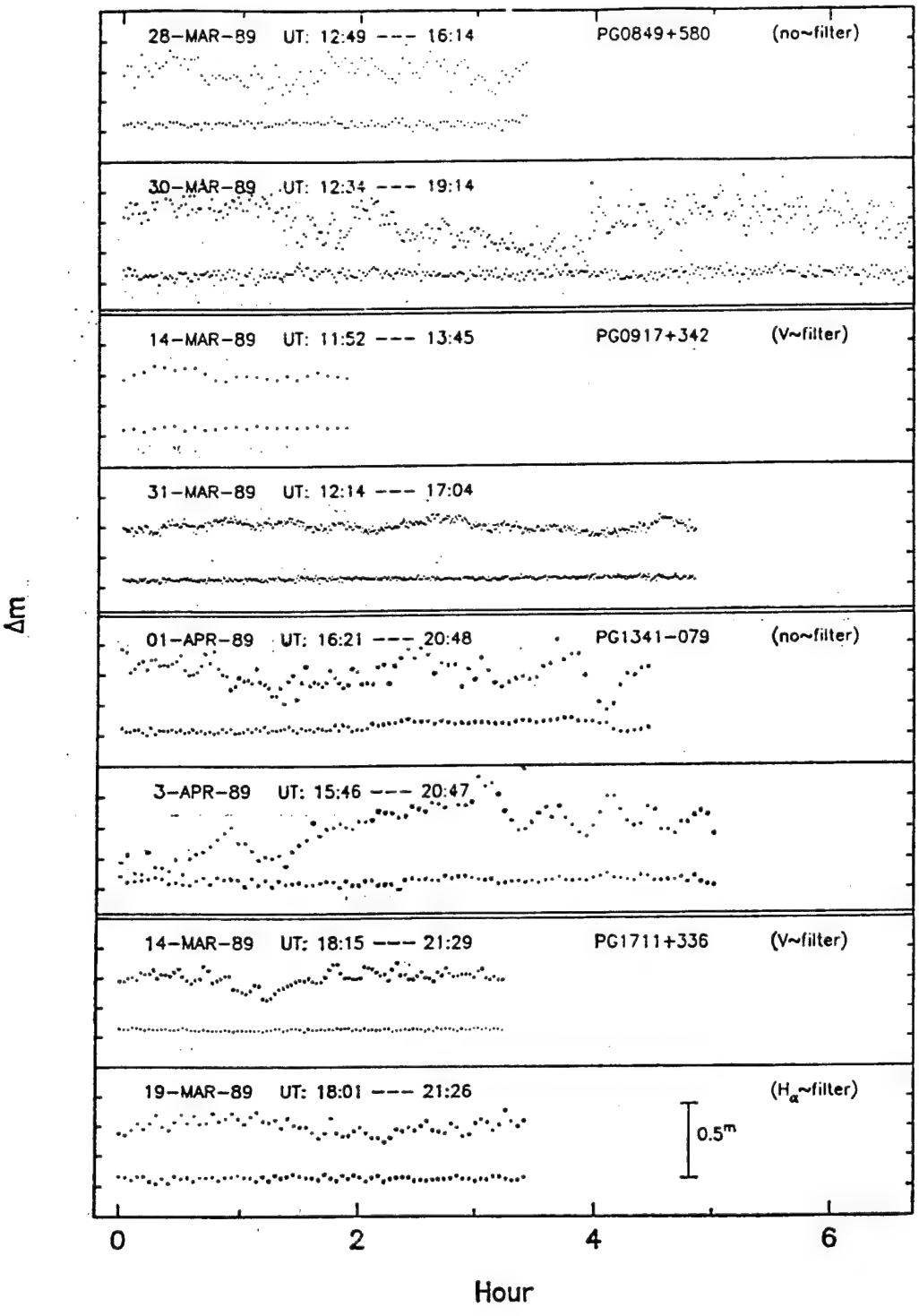

PG1717+413
08-APR-89 UT: 18:22 --- 20:55
09-APR-89 UT: 16:29 --- 20:55
26-JUN-89 UT: 15:37 --- 18:48
27-JUN-89 UT: 13:15 --- 14:07
27-JUN-89 UT: 16:06 --- 19:37
28-JUL-89 UT: 13:07 --- 14:30
0.5m
Δm
0
1
2
3
4
Hour
/228

Fig.1 (cont'd)


31-OCT-89 UT: 20:02 --- 21:30
PG0244+104 (V~filter)
27-JUL-89 UT: 16:03 --- 20:05
PG2240+193 (no~filter)
1-APR-89 UT: 12:02 --- 15:18
PG0948+344 (no~filter)
26-JUL-89 UT: 17:51 --- 19:28
PG2300+166 (no~filter)
5-NOV-89 UT: 11:58 --- 14:32
(R~filter)
6-NOV-89 UT: 11:10 --- 13:10
(R~filter)
0.5m
Δm
0
1
2
3
4
Hour


28-MAR-89 UT: 12:49 --- 16:14
PG0849+580
(no~filter)
30-MAR-89 UT: 12:34 --- 19:14
14-MAR-89 UT: 11:52 --- 13:45
PG0917+342
(V~filter)
31-MAR-89 UT: 12:14 --- 17:04
01-APR-89 UT: 16:21 --- 20:48
PG1341-079
(no~filter)
3-APR-89 UT: 15:46 --- 20:47
14-MAR-89 UT: 18:15 --- 21:29
PG1711+336
(V~filter)
19-MAR-89 UT: 18:01 --- 21:26
(Hα~filter)
0.5m
Δm
0
2
4
6
Hour

In this, PG0834 + 488, PG1717 + 413, and PG0244 + 104 were /229 also observed by Wilson and others. In all cases, it was determined that there was small range flickering. The results agreed with ours [9]. PG1711 + 336 was observed by Shafter and others and determined to be an eclipsing binary. In conjunction with this, a solution was made for line of sight direction velocity curves [10]. Kaluzny carried out frequency analysis on light change curves associated with the stars in question [11].

5. As far as PG0948 + 344 is concerned, flickering has not yet been observed. However, its brightness--within 3 hours--shows variations with a range that is $0^m.1$. After /230 increasing brightness, it gradually gets dark. Further observations are needed in order to determine whether or not the variations have a periodic nature.

6. With regard to our observations of PG2240 + 193 and PG2300 + 166, within the precision of the observations, it was not possible to confirm the existence of flickering or other

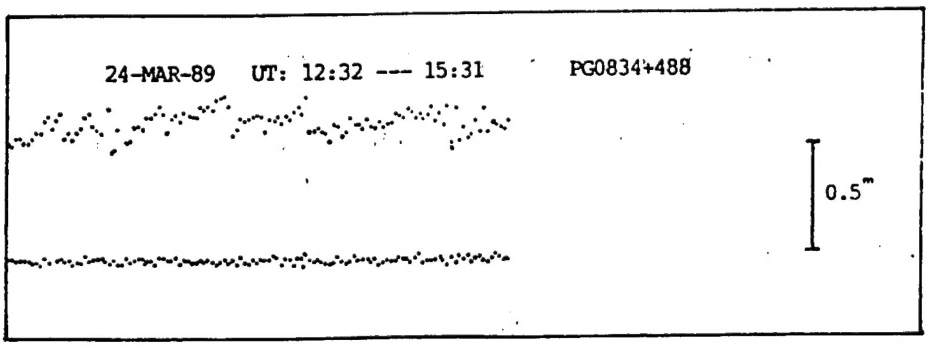


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Fig.1 (cont'd)

light variations. Wilson and others reported observations of their flickering [9]. However, signal to noise ratios and the results of our observations are equivalent. The diffusion associated with light change curves is too great. It is still difficult to determine the basic nature of cataclysmic variables.

7. When PG1717 + 413 was observed in April, 1989, the optical change flickering range was approximately $0^m.05$.

However, as far as observations in June and July are concerned, flickering ranges had increased to be $0^m.2$. Moreover, in the case of changes in the variable star itself (white light), if one uses April 9 as the datum, then, there was an increase in brightness to $0^m.2$ on June 26, and brightness increased to $0^m.3$ on June 28. However, on July 28, it returned to the level of April 9. As a result, there is no clear correlation between flickering range and the luminosity of the variable star per se. It seems that changes in flickering ranges could not be given rise to by luminosity variations associated with accumulator panels. What is more probable is that they are due to the localized effects of thermal striations on accumulator panels. There is still a need for further observations to get a clear picture of cycles in flickering changes or time scales. As far as variations in flickering ranges associated with PG1717 + 413 are concerned, they present an important example. The explanation may be that CV flickering may possibly have quiet periods and active periods. As a result, despite the fact that, within the period of our observations, PG0948 + 344, PG2240 + 193, and PG2300 + 166 did not give rise to any clear flickering, it is still not possible, on the basis of this, to deny their CV characteristics. There is still a need to have longer observation periods of coverage.

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